

EP - 1 101 934 - A2

[0001] The invention relates to a wind-powered device as well as a method to the exchange of the main components of the machine housing of a wind-powered device by means of onboard means.

[0002] For the assembly of a wind-powered device either very large cranes required are, in order to lift the machine housing (also gondola mentioned) as whole (weights up to 100 t with present gondolas), or the main components of the machine housing single on the tower are lifted. With the main components it acts mainly around the rotor, existing out of rotor hub with at least a rotor blade, the main shaft with wave storage, the generator and between shaft and generator connected gearboxes. These main components form the driving rank of the wind-powered device. As is the case for the assembly, then one of these main components is as well as for the assembly and the exchange of the rotor a crane required also with the exchange.

[0003] This problem is intensified in the moment, in that the weight of the gondola to the boundaries of the crane capacity comes and/or, this exceeds or wind-powered devices in less strong industrialized countries, in which for example mobile cranes are not available so easily, operated becomes. Here it offers itself to provide the wind-powered device with an onboard crane system as it is in at-PS 401674 described. Is however to be considered that these deck crane systems for at present far common VKA concepts inappropriate are or very stable and thus heavy-weightily formed must be, to be able to raise in order the individual components with from the housing out collar that crane discharge and.

[0004] In DE 196 47 515 A1 and DE 197 41 988 A1 become methods the structure of a wind-powered device described with which the structure of the tower by Aufeinandersetzen of single tower segments along this high-mobile crane becomes used, that finally also the machine housing and its main components the Turmspitze carried. From DE 28 23 525 A1 is finally known, the machine housing by means of ropes, which are guided back on the basis of a wind over deflection on rollers at the upper end of the tower, arranged at the ground of the tower, downward to raise.

[0005] It is already at the trade fair "Sustain '99 - The World Sustainable Energy fair" (25. to 27. May 1999) by the applicant wind energy for the first time the public a concept presented, with that the generator by means of an onboard crane system by an opening in the bottom wall of the machine housing from this out discharged and/or, into this in-carried becomes. With this concept however still the problem exists that in case of a gearbox trouble the gearbox further by means of an external crane upward from machine housing lifted out and/or, from above into the machine housing inside lowered will must.

[0006] The invention is the basis the object to create a wind-powered device which is in such a manner constructed while maintaining a preserved machine concept that the single on-board components of the machine housing on simpler way by means of one onboard crane system exchanged and/or, mounted to become to be able.

[0007] The solution of this object a wind-powered device becomes according to claim 1 proposed with the invention.

[0008] As is the case for a wind-powered device conventional, are in and/or, at machine housings a shaft with at least one Wellenlager, a gearbox, a generator and a rotor arranged on a tower. These components (subsequent also as main components designated) form the driving rank of the wind-powered device and are along an axis of the machine housing adjacent and among themselves mechanically connected arranged.

While the shaft from side of the machine housing stands out, the gearbox essentially is within the machine housing in extension of the tower, while the generator is in a radial part of the machine housing which is away from the tower accommodated. At the shaft the rotor with an hub is fixed, from which at least a rotor blade radial is away. Underneath the generator an opening is in the bottom wall of the machine housing. Furthermore a deck crane system in the machine housing of the wind-powered device according to invention, which is formed as pivotal and/or movable gantry crane system in particular, is.

[0009] The opening is according to invention in the bottom wall of the machine housing in such a manner dimensioned that one by this opening both the generator and with not present generator, thus with not yet mounted or already disassembled or of the opening away-pushed generator, which can through-transport gearboxes. For this purpose the deck crane can be maneuvered in such a manner that after the discharge or shifting the generator the gearbox can move if necessary within the housing to over the bottom wall opening and be discharged then by the bottom wall opening. The reversed procedure takes place then at the incorporation of the gearbox.

[0010] With the invention thus proposed becomes, the opening in the bottom wall of the machine housing for the gearbox and/or. not only for the assembly, the incorporation and the removal of the generator to use but also for the gearbox.

[0011] In order to hold the volume of the machine housing despite housing of an onboard crane system a relative small, is in accordance with a favourable development of the invention provided to plan in the upper surface of the machine housing an opening which can become with or several flaps a sealed and an opened. It is still more favourable, if by means of corresponding folding and/or. Cover constructions the entire upper machine housing half to open unfold leaves itself. The deck crane can become then from a park position, in which it exhibits hinged away or on other way an only small overall height, into a work position erected, in which it stands out above from the machine housing by the opening. A lateral out collar of the deck crane to the side and/or to the rear from the machine housing is however not provided after the invention, there the generator and the gearbox over the bottom wall opening from the machine housing discharged and/or. until into this lifted become.

[0012] Furthermore the machine housing of the wind-powered device according to invention is preferably provided beside the generator arranged crane hatch with one, by which through the frame of the crane or at least the rope to outside of the machine housing is more movable. Thereby all Nebenaggregate of the machine housing, as for example radiator, can be discharged oil pumps, azimuth drives etc., downward and/or. raise upward. In order to avoid that components strike with the discharge by wind turbulences to the tower, these components become appropriately guided by suitable devices, as for example a tensioned steel cable or an outer guide rail mounted at the tower wall.

[0013] The propulsion of the course organ, at which it concerns in particular a rope, can be in the machine housing accommodated. In order to have to make for this in the machine housing however no place available, it is convenient, a rope hoist or such full trailer combination organ drive at the foundation and/or. to arrange at the lower end the tower, over then the rope by the tower and/or. to lead out at the tower past to above into the machine housing. The wind becomes then mounted (cost saving), for the durations of the assembly activity.

[0014] By the deck crane of the wind-powered device according to invention movable over the whole length of the housing (considered in axial direction of driving rank) it is possible beyond that to discharge with this deck crane also the shaft and the

main shaft can and/or, to lift into the machine housing. Both can both over the bottom wall opening and over the front of the machine housing (, where the rotor is arranged) takes place. The case specified last makes it for required that the deck crane in such a manner more movable and/or, it is more pivotable that the auskragt over the front of the housing. This has beyond that the advantage that the deck crane can become now also used for the assembly and the exchange of the rotor. The assembly of the rotor can take place now in such a way that first the hub lifted and at the shaft fixed will, in order to raise and fasten to the hub thereafter that at least rotor blade or all rotor blades a single. The same process steps take place in reverse order with the decrease of the rotor. If no rotor at the shaft is mounted, this leaves itself with crane system auskragbarem over the front if necessary. discharge after previous removal of the main bearing or with this together and raise.

[0015] Further it is convenient, the crane with mounted rotor for raising and/or. To begin discharge of the installations of the hub (for example rotor blade adjustment system).

[0016] Subsequent one becomes on the basis the drawing an embodiment of the invention more near explained. On the basis the single Fig. 1 to 6 thereby the schematic structure of the machine housing and the single process steps for the exchange of the main components of the machine housing and the rotor illustrated become. It is to be noted that the single process steps in reverse order with the assembly and with the incorporation of the main components and/or, the rotor run off. The Fig. 7 to 9 shows other alternatives of wind-powered device constructions and the assembly as well as disassembly of the rotor.

[0017] In Fig. 1 is the structure in principle of a wind-powered device 10 in accordance with a preferred embodiment schematically illustrated. On a foundation 12 is the tower 14, 20 rotatably supported at whose upper end a machine housing 18 around a vertical axis of rotation. The machine housing 18 exhibits transverse to vertical axis 20 the directed longitudinal extent 22 and is away with its housing part 24 radial from the tower 14. At the front end 26 of the machine housing 18 the main bearing 27 the shaft 28 is in this, is 29 fixed at which the rotor. The rotor 29 exhibits an hub 30 also in the rule in, two or three rotor blades 31. The shaft 28 is mechanical 32 connected with a gearbox, which is 36 connected over a high-speed shaft 34 with a generator. Optional ones are in the machine housing 18 a transformer of 38 as well as various switchgear cabinets 40.

[0018] The generator 36 stands on feet 42, bottom those two 22 crossbeams 44 arranged longitudinal transverse to the longitudinal extent is. The crossbeams 44 are from downside 18 fixed at two stringers 46 of the machine housing from each other longitudinal in longitudinal extent spaced 22 and. Below the crossbeams 44 and the stringer 46 is in the bottom wall 48 of the machine housing 18 a bottom opening 50, which is in such a manner dimensioned that the generator 36 itself by this opening through into the machine housing 18 inside and/or, from the machine housing out-move 18 leaves.

[0019] Alternative one to the storage of the generator on crossbeams can be flanged on these also direct at the gearbox 32.

[0020] The conveyance of the generator 36 from the machine housing 18 out and/or, into this inside made by means of an onboard crane 52 formed as swiveling gantry crane, which exhibits a frame 53 with two pivotal crane arms 54. In Fig. 1 is the deck crane 52 in its park position illustrated, 18 accommodated in which he is complete in the machine housing. With 56 are in Fig. 1 hinge axes for two cover flaps 58 of the machine housing illustrated, which are symmetrical 22 arranged to

the longitudinal extent. By opening unfold these cover flaps 58 the machine housing is 18 upward opened, so that now the swiveling gantry crane can become 52 erected (S. Fig. 2). Down at the foundation 12 of the tower 14 a rope hoist 60 can be installed, from which a rope 62 in the tower or outer at the tower 14 into the machine housing 18 and from there over a deflection roller 64 up to the upper end 66 of the crane arms 54 runs past. The discharge of the generator 36 the swiveling gantry crane becomes 52 in such a manner pivoted that the upper ends 66 of its arms are 54 36 arranged above the generator. Now the generator 36 can do 50 through discharged by the bottom opening and/or. Lifted become.

[0021] The assembly and/or. the exchange of the gearbox 32 can take place if the generator 36 yet in the machine housing 18 is not or if it is moved away to the side or to the rear from the bottom opening 50 into an intermediate position or is in its operating position outside of the bottom opening. The opening 50 in the bottom wall 48 is in such a manner dimensioned that the gearbox 32, which exhibits larger dimensions in the rule transverse to the longitudinal extent 22 of the housing can become likewise transported by this opening 50 through. The transportation of the gearbox 32 within the machine housing 18 made thereby by corresponding turning of the crane arms 54. Depending upon embodiment of the storage of the shaft 28 (bottom inclusion of the gearbox as the second bearing point - so called three point storage) it can be required to fix the shaft by means of a wave holding down device 70 before the gearbox can become 32 disassembled.

[0022] Into the Fig. 2 and 3 is fastening 68, e.g. commercial heavy load chain courses, illustrated, with which the swiveling gantry crane is lockable 52 on the one hand at the machine housing 18 and on the other hand at the hub 30 of the rotor 29. The swiveling gantry crane 52 can in place of these fastening and/or. additional to these fastening over hydraulic stamp/cylinder units order, with which the crane arms 54 can be swivelled.

[0023] By swivelling of the crane arms 54 toward the front end 26 of the housing 18, until the ends manage 66 of the crane arms 54 over the rotor 29, the swiveling gantry crane 52 can be begun also to the assembly as well as disassembly of the rotor 29. In the illustration in accordance with Fig. 4 first each single rotor blade 31 removed becomes, whereby one in each case that rotor blade 31 mounted and/or. disassembled, vertical downward at the hub 30 mounted is pointing and/or. to attach is. After all rotor blades are 31 removed in this way, the hub 30 can be discharged (S. Fig. 5). After this made is, now the main shaft camp 27 can if necessary, with the main shaft 28 by means of the swiveling gantry crane 52 discharged become. Thus thus the last main component of the machine housing becomes 18 likewise 52 discharged with the help of the swiveling gantry crane and/or. lifted.

[0024] With the wind-powered device according to invention 10 thus all components located in the height can be installed by onboard means and/or. dismantle. This represents a whole critical advantage, if one wants to develop of the wind-powered device at locations, at which external cranes is not so easily more available. Here also the field of application of the offshore installations is mentioned, at which so far with Schiffskranen one works, which must adjust movements of the hull, over the main components to install and/or. dismantle to be able.

[0025] In Fig. 7 is a schematic alternative construction of a wind-powered device 10 with two-sheet rotor shown. So far in Fig. 7 parts shown of the wind-powered device 10 those the wind-powered device 10 the Fig. 1 to 6 same and/or. functionally, are provided they correspond with the same reference numerals.

[0026] In Fig. 7 is the structure of the machine housing 18 so selected that the

bottom opening 50 is only partial either not at all or covered of the generator 36 in its operating position. In the first mentioned case the generator 36 in its operating position outside of the bottom opening 50 can remain, if the gearbox must become 32 exchanged. In the case secondarily mentioned it is required, the generator 36 from its operating position, in which it partly the bottom opening 50 covered to shift into an intermediate position within the machine housing 18 so that then the bottom opening is 50 exposed, in order to exchange the gearbox 32.

[0027] Fig. a machine housing 18 with one shows 7 as gantry crane 52 ' implemented crane system, which exhibits a trolley 55 movable on the frame 53. In order to be able to work at a such gantry crane system also still before the rotor 29, the frame exhibits 53 two swinging arms 54, which are 53 pivotally supported at the frame. Alternative ones can be the pivotable arms 54 also 53 rails formed telescopic as from the frame, on which then the trolley is more movable 55 to over and before the rotor 29.

[0028] Depending upon weight and size of the rotor 29 this leaves itself either as unit in an horizontal position (S. Fig. 8) or in parts in a Vertikalstellung (S. Fig. 9) install and/or. dismantle. In the latter case it is required that the gantry crane is 52 ' to its to over and before the rotor 29 pivotable front end "bifurcated", so that the two swinging arms 54 are reciprocal the upstanding rotor blade 31 arranged.